Research

Colloquium

The global dynamics of enharmonic oscillators

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時　間：112 年 11 月 22 日（三） 14：30

地　點：應用數學系多媒體教室(理 408 室)

摘　要：

Discrete-time delays often arise in real-world problems, such as maturation times in population dynamics, time-delayed feedback loops in laser devices, and heat transfer lags in atmospheric models. Mathematically, delay differential equations (DDEs) produce dynamics in an infinite-dimensional phase space and contain complicated dynamics. In the talk, I will present the main result of my doctoral work [1] by introducing the enharmonic oscillator, a scalar DDE of the special form

$$\dot{x}(t) = f(x(t), x(t-1)) := -\Omega\left(x(t)^2 + x(t-1)^2\right) x(t-1).$$

Here Ω is a positive nonlinear frequency function and f is assumed to decrease monotonically in the delayed component, i.e., $\partial_2 f < 0$.

Our main conclusion is that, the structure of the maximal compact invariant set $\mathcal{A}$ can be described in detail. More precisely, $\mathcal{A}$ possesses a graph structure whose vertices correspond to periodic or stationary solutions of the delay equation and whose edges represent heteroclinic orbits connecting the vertices. We conclude that the frequency Ω contains the connection graph and provides an explicit method to recover the connectivity.

References

[1] L´opez-Nieto, A.: Enharmonic motion: Towards the global dynamics of negative delayed feedback. Dissertation, Freie Universität Berlin (2023), http://dx.doi.org/10.17169/refubium-40043.